



U.S. Army
Armament Research, Development & Engineering Center
Picatinny, NJ



120mm LOS-MP

LINE OF SIGHT MULTI-PURPOSE

Army Science Conference

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Brief Outline



- **Program Overview**

- Exit Criteria

- **XM1069 Design**

- Process
- Cartridge
- Warhead
- Fuze (XM1157)
- Data Link

} **Modeling & Simulation**

- **XM1069 Testing**

- Warhead
- Structural
- Concrete Wall
- Anti-Personnel

} **Test & Evaluation**

- **Conclusion**



120mm LOS-MP
LINE OF SIGHT MULTI-PURPOSE



LINE OF SIGHT MULTI-PURPOSE (LOS-MP)

Present: 4 Rounds



Target Set

ANTI-PERSONNEL



CONCRETE WALLS



BUNKERS



LIGHT ARMOR



Future: 1 Round

XM1069



The LOS-MP
combines capabilities
of M1028, M830A1,
M908 and M830
into ONE Round

Improved Lethality with Reduced Logistic Burden



Program Overview



- **Subset of 120mm MCS and Abrams Ammunition System Technologies (MAAST) ATO**
- **LOS-MP TRL6 Exit Criteria**
 - ☐ Double reinforced concrete wall
 - Hole size 30"x50" in 3 shots or less
 - ☐ Anti-Personnel:
 - 200-700 meters Threshold
 - 40-2000 meters Objective

***All technical data
Government generated
and owned***



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LOS-MP Design Process



Decrease design time and tests

Initial conceptualization to meet requirements

Definition of high risk process and long lead items

Define shortfalls of M&S: Fill gaps with test, experience

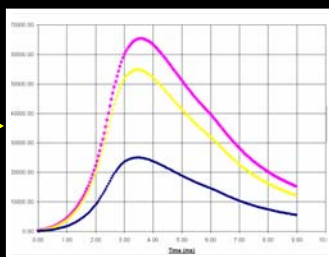
M&S Savings:

\$6.8 mil/27 months

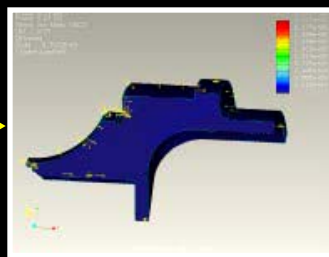
Modeling/ Configuration
Pro Engineer/ Intralink



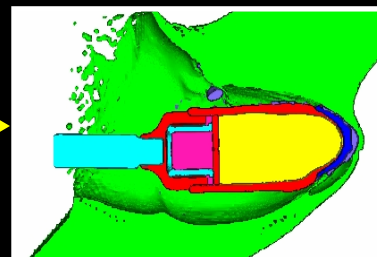
IB Simulation
IBHVG2



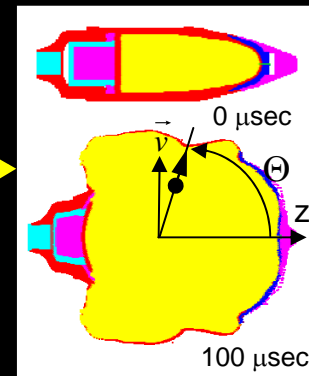
Structural analysis
FBD/ ANSYS



Target penetration
CTH



Fragmentation
CALE/PAFRAG



Failure in any model reiterates design process

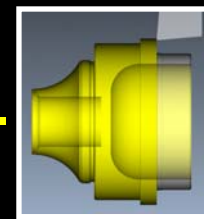
Flight Performance



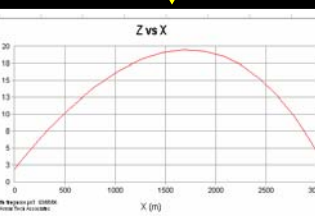
Fragmentation



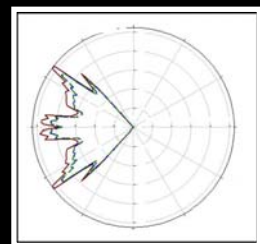
Verify models



3D numerical control
Pro Manufacture



Flight performance
PRODAS



Lethality Models
CASRED/MP3D/
AJEM/MUVES



DR concrete wall

No iteration of design during testing !



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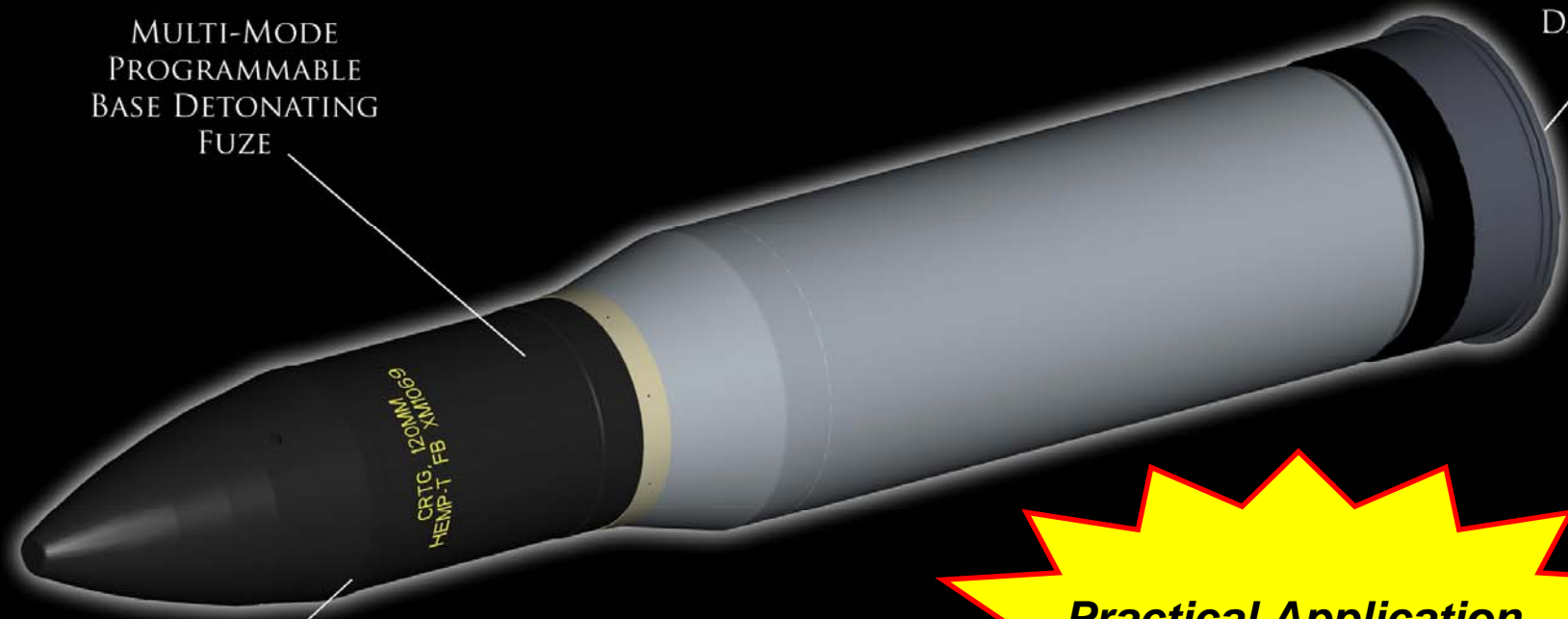


XM1069 CARTRIDGE



MULTI-MODE
PROGRAMMABLE
BASE DETONATING
FUZE

DATALINK



TARGET-PENETRATING
BLAST-FRAGMENTING
WARHEAD

***Practical Application
of
New Technology***



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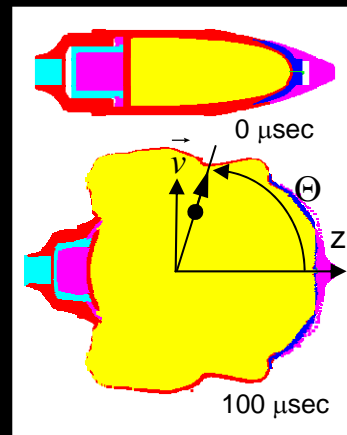


XM1069 Warhead Design

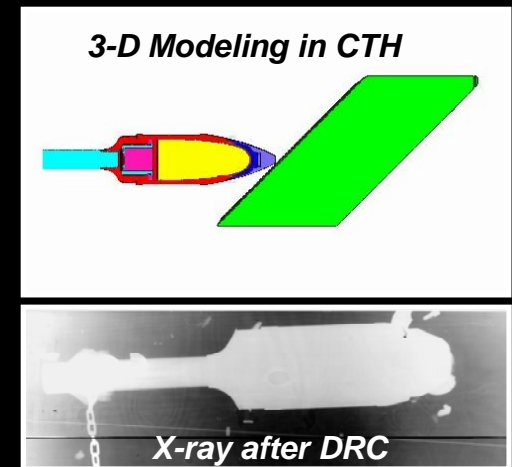


- **Blast fragmenting target penetrating**
 - Iteration of CTH/ CALE-PA FRAG modeling
 - Structural integrity for:
 - Concrete Wall
 - Earth and Timber Bunker
 - Delivers intact warhead and fuze to target sweet spot
 - Fragmentation:
 - ~20000 total fragments

4 Patents Pending



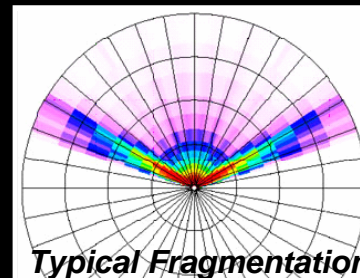
CALE/ PAFRAG predictions



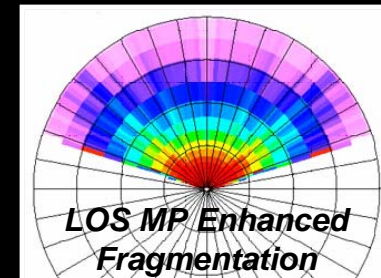
3-D Modeling in CTH



X-ray after DRC



Typical Fragmentation



LOS MP Enhanced Fragmentation

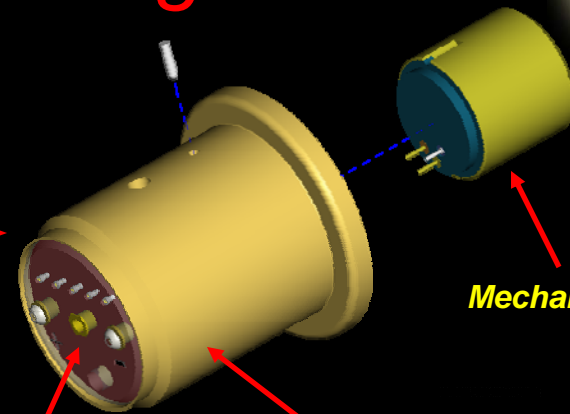
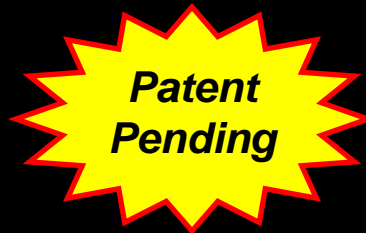
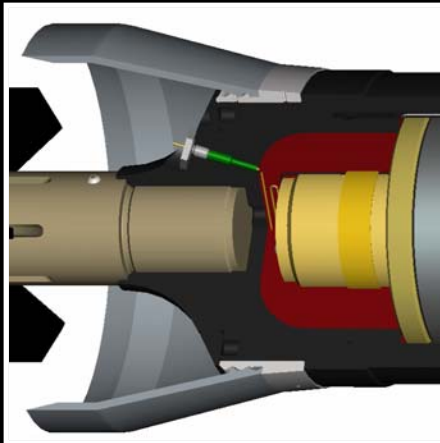
Survivable & Lethal



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XM1069 Fuze Design



Mechanical S&A

*PD switch connections and
center data link connection*

Electronics Control module

- **Multimode Programmable Base Detonating (XM1157)**

- 5 modes: 4-Point Detonate, Timed airburst
- Dual safe: Setback, commit to launch
 - 3 leaf mechanism
 - Electronically controlled piston actuator
- Power, function mode and time sent via data link
- S&A
 - No rotating contacts
 - 90 degree rotor
- Electronics
 - Dual Micro-controller
 - Enhanced Capabilities



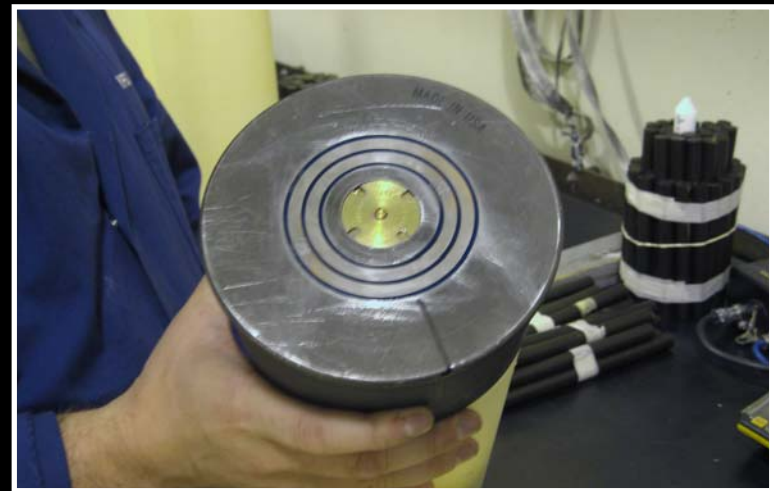
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XM1069 Data-Link



- Provides ability to:
 - Power fuze
 - Set function mode & time
 - Verify data and munition status
- Primer ignition isolated from data transmission



***Utilizes production
primer and case base***



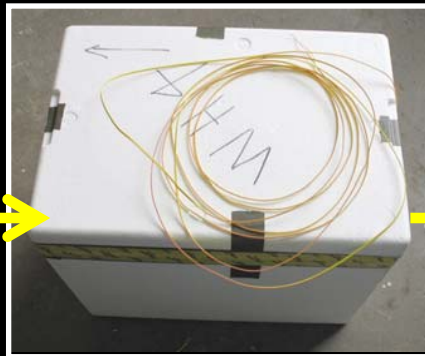
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Warhead Testing: Frag Recovery



- **Fragment Recovery**
 - Fragment recovery determines efficiency of warhead to produce desired fragment size and number
 - Fragmentation recovery results validate and refine PAFRAG/CALE modeling data



93% fragment mass recovery was achieved



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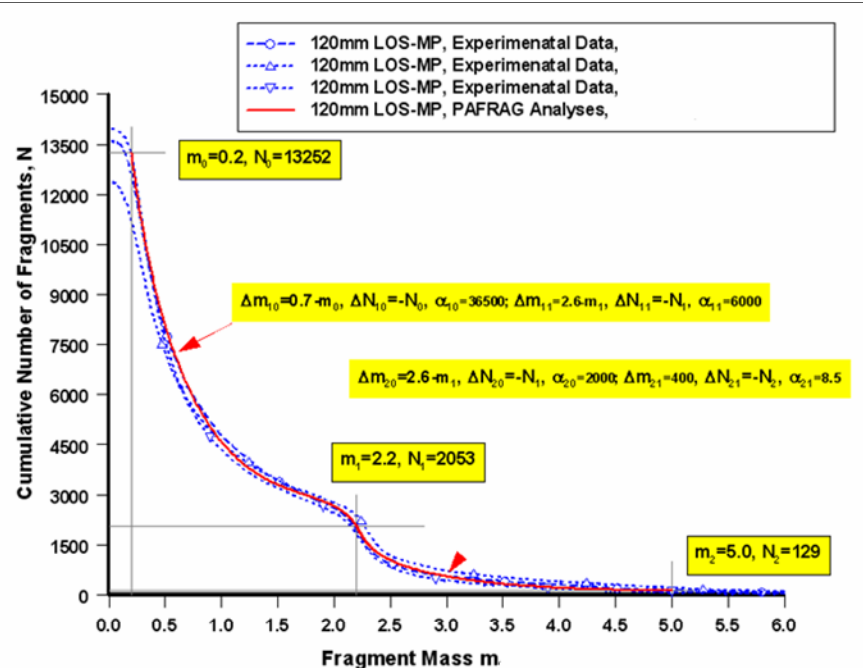
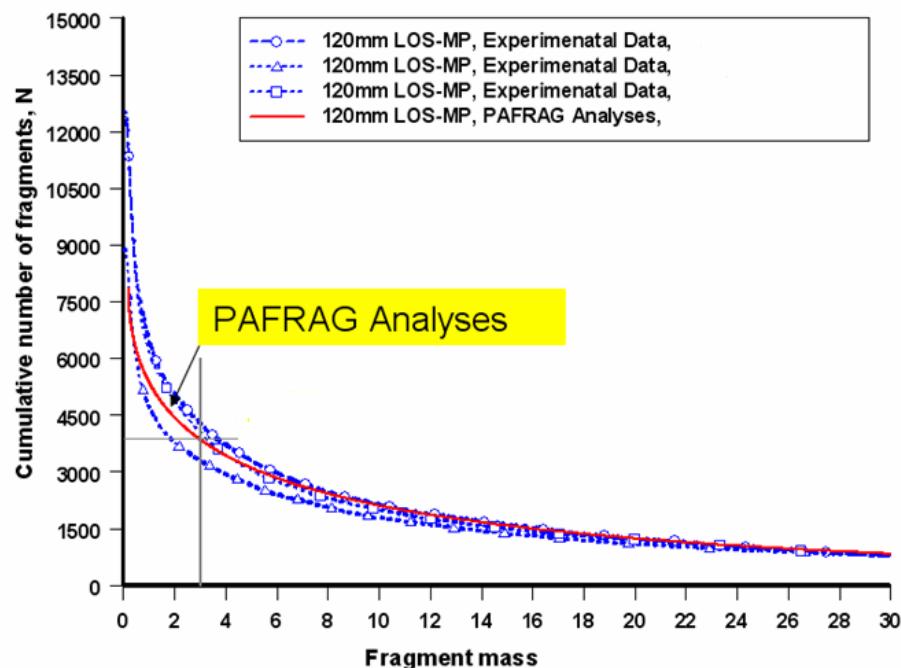
Fragment Recovery Data

Experimental vs CALE/ PAFRAG Analysis



Body Fragment # vs Mass

Nose Fragment # vs Mass



**Simulation predicted
experimentation**

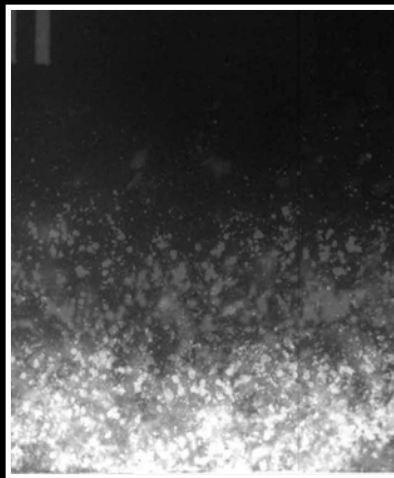


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Warhead Testing: Frag Velocity

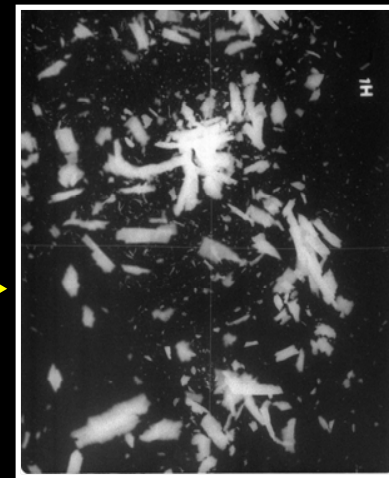
- **Fragment Velocity**
 - Determines static detonation fragment velocity
 - Fragmentation velocity results validate and refine PAFRAG/CALE modeling data



Nose Fragment Velocity
Test: 0.740 mm/ μ s
Predicted: 0.750 mm/ μ s



Fragment Velocity
Test Setup



Body Fragment Velocity
Test: 1.360 mm/ μ s
Predicted: 1.200 mm/ μ s



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Projectile Structural Testing

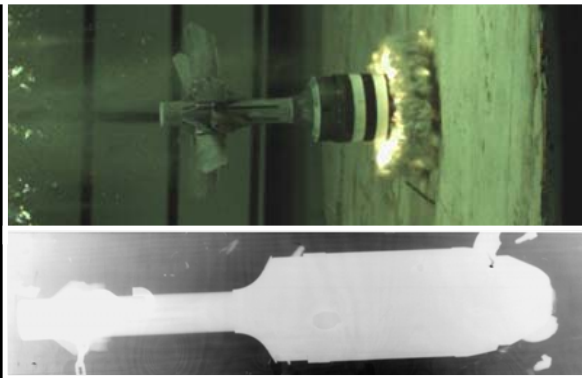


- XM1069 Structural Testing
 - Validate Propulsion models
 - Validate FEA models
 - Validate CTH model
 - Evaluate target deceleration (for fuze programming)
 - Concrete/ Double Reinforced Concrete: Equal difficulty
 - E&T Bunker hardest on airframe

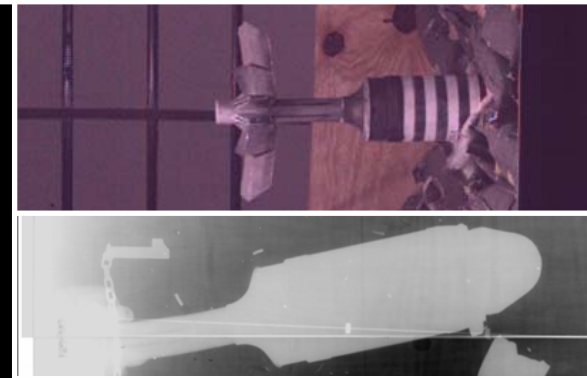


Muzzle Exit Integrity

DR Concrete Wall
Energy Decrease: 32KJ
Velocity Decrease: 60 m/s



E&T Bunker
Energy Decrease: 210KJ
Velocity Decrease: 162 m/s

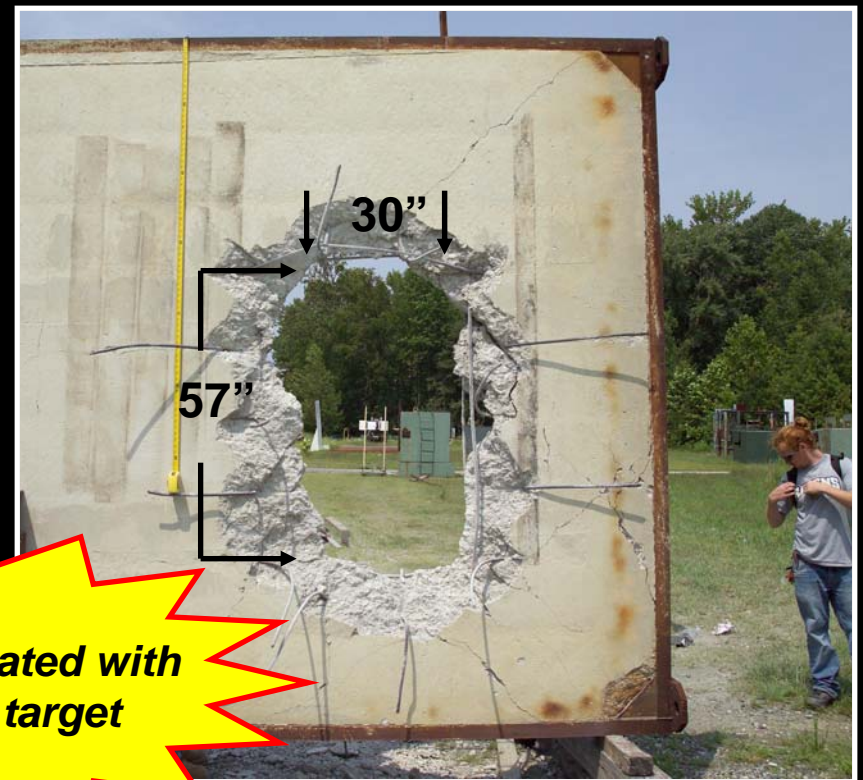


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TRL6: Concrete Wall Test

- Demonstrated XM1069 integrated with XM1157 fuze & data link
- Defeated target in 2 shots



**Warhead integrated with
fuze defeats target**

MOUT standard 8" double reinforced wall



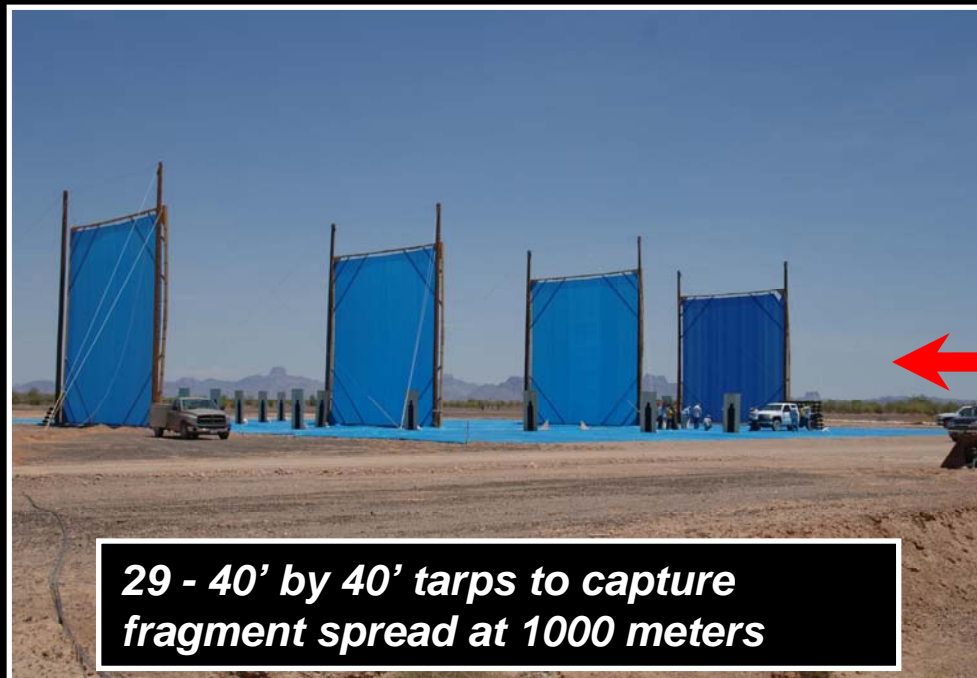
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TRL6: Anti-Personnel Test



- Demonstrated airburst performance between threshold and objective ranges



29 - 40' by 40' tarps to capture fragment spread at 1000 meters

**Performance shown at
1000 meters**



Sample silhouette from test:

- Large Dots: Body frag hits
- Small Dots: Nose frag hits

**Fired from Abrams SEP
Tank with Data link**



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Conclusion



- **LOS-MP TRL6 Exit Criteria has been met**
 - ✓ Double reinforced concrete wall
 - Hole size 30"x50" in 3 shots or less
 - ✓ Anti-Personnel:
 - 200-700 meters Threshold
 - 40-2000 meters Objective
- M&S reduced time and risk
- Testing validated and refined M&S
- LOS-MP technology transitioned to PM-Maneuver Ammunition Systems for potential Advanced Multi-Purpose SDD



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LOS-MP Team Acknowledgments



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Jesse Sunderland

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Dave Pfau

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Barry Schwartz
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Andy Ponikowski

Propulsion
Carlton Adam

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Nidal Eid

Safety
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ARDEC Shop
Josh Gallagher

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